some of the uses of the katathermometer have been discussed before.[2] There is such a great mass of material presented in the two volumes, which constitute the two parts of the work, that it affords a very prolific source of information for those who are interested in this subject.

Some of the chapter headings from the two parts will serve to indicate in a general way the nature of the material and the discussion. In Part I we find: The cooling power of the atmosphere and its measurement by the katathermometer; the conductivity of the skin and heat-loss in relation to surface and deep temperature; the influence of the atmospheric environment on the respiratory membrane; records of observations in numerous places under varied conditions such as cool, sunny, and close days in Egypt, army huts, tents, school rooms, playgrounds, etc.

Part II deals with the chemical purity of the air, radiant energy, sunlight and pigment, heat-stroke, clothes, ventilation and heating of dwellings and work rooms, housing, sickness, and mortality, and open-air treatment.—*C. L. M.*

[2] Atmospheric Conditions which Affect Health, *Quar. Jour. Royal Meteorological Soc.*, July, 1919, pp. 189-207. Abstract reprinted from *Science Abstracts* in Mo. Weather Rev., Nov. 1919, p. 810. Also review by Ellsworth Huntington in *The Geographical Review*, April-June, 1920, pp. 362-363.

CLIMATE AND ITS RELATION TO ACUTE RESPIRATORY CONDITIONS.

By Lt. Col. ESTES NICHOLS, M. D.

[Excerpts from paper read at the meeting of the American Climatological and Clinical Association, at Atlantic City, N. J., June 17, 1920.]

Following the last three years, 1917–18–19, during which time we have experienced a remarkable prevalence of acute respiratory diseases not previously met and studied to such an extent by this generation of observers and in reviewing many reports from all parts of the world, we frequently note reference as to the causation of epidemic bronchitis, influenza and pneumonia and their relation to certain meteorological conditions which, if not held responsible for them, are indicated as having a great influence upon the spread or the sudden termination of these diseases. As these references are made by the most serious writers, it seems necessary for us as climatologists to study carefully every meteorological condition that may have any bearing on such a formidable disease as influenza and pneumonia.

What were the unusual weather conditions, if any, prevailing to account for this most serious bacterial attack upon the human race? For instance, a medical writer in Spain states: "After the subsidence of the epidemic of influenza in Spain last spring, the summer was extremely dry, the drouth being worse than even the oldest inhabitants could remember, and the epidemic flared up again in a much severer form, and the disease, which first seemed to yield to the extreme hot weather, suddenly spread throughout the whole of Spain."

Another writer, from the Philippines, states that "The disease ravaged in the islands for about six weeks, when a typhoon with torrential rain followed by strong winds swept away the last vestige of the disease."

Baccarini is inclined to believe that the germs causing it had their virulence suddenly enhanced by some mysterious influence, electric, atmospheric, or telluric. Another writer states "The epidemic appeared after a very hot season had suddenly been succeeded by a very cold one and that perhaps the weather precipitated a large amount of other respiratory infections such as always become prevalent at this season (autumn)." This is answered by many other writers who state that this pandemic differs from that of 1890 and 1892 in that acute nasal catarrh and sinus involvement were conspicuous by their absence this year. It is also said that among the causes which contributed to the high incidence of influenza-pneumonia in the American Expeditionary Forces were working and sleeping in wet clothes and shoes, eating of food served cold, insufficient blankets for warm sleeping during the wet, cold period in northern France, yet several exhaustive reports of the incidence of influenza-pneumonia among troops stationed in barracks and tents in this country show that the weather conditions when the epidemic struck were unsurpassed; no rain, not cloudy, fair and warm—the weather being all that one could wish for the troops occupying tents, and that a long period of fine weather followed the onset of the pandemic. In letters sent out by a medical association for the prevention of disease, a slip was inclosed which reads: "Spanish influenza is undoubtedly due to lack of sunshine and fresh air, to dampness out doors and in, and to getting wet feet." This is not quite as amusing as a special telegram to one of the leading Philadelphia papers dated Boston, October 7, which reads thus:

"In connection with the influenza epidemic the directors of the 'Mother' Christian Science Church here announce that the mind is a source of contagion and that elements can contaminate only as diseased images held before the thought and paraded before an excited imagination preliminary to having them expressed on the body through fear and apprehension." Another writer states "The numerous gases used on the battle fields of Europe with their highly poisonous properties, the liberation of large quantities of ground air high in carbon dioxide content due to trench digging and shell holes, the gases from decomposing bodies of men and lower animals, and those set free by the destruction of cities and munition dumps during the last four years may have combined to form a gaseous compound with highly toxic properties probably due to rearrangement of molecules by the tremendous concussion produced by high explosives." With this idea in mind he states, "I am going to advance the theory that the condition termed influenza is in reality a nonbacterial, noncontagious disease caused by the inhalation of small amounts of depressing, highly irritating, high density gas present in the atmosphere, especially at night when the air is surcharged with moisture, more particularly near the surface of the earth." He also states, "The mode of transmission is undoubtedly through the agency of the atmosphere."

The idea that some atmospheric influence or free-from-germ explanation of infections and epidemics was promulgated by Wagner many years ago in his work on pathology under the title of "The Epidemic Constitution of Disease."

Dr. Onodera, of the Society of Internal Medicine of Japan, has laid stress on the meteorologic relation of the occurrence of influenza epidemics, the latter running parallel with the severe cold that returns at about 30-year intervals. There may possibly be some relation of extreme cold periods and crowding.

MONTHLY MEAN TEMPERATURE.

	1890	1891	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918
September	62.9	66.4	65.5	62.8	64.5	64.2	64.1	62.6	64.4	68.1	64.2	61.1	61.0
October	51.3	50.7	56.2	51.5	55.8	53.2	56.7	57.7	57.1	55.5	55.3	50.7	56.0
November	41.7	40.9	42.9	46.1	40.7	40.8	44.8	45.4	42.5	44.6	43.2	39.4	44.4

TOTAL MONTHLY PRECIPITATION.

September	5.38	3.96	0.88	3.93	1.83	2.33	2.32	2.52	0.17	1.35	2.54	2.23	6.16
October	7.63	4.62	1.58	1.76	1.15	7.44	1.22	10.64	3.81	3.30	2.05	4.68	1.20
November	0.67	2.21	0.83	1.51	4.56	6.40	3.37	2.74	3.28	1.90	2.54	1.08	3.37

MONTHLY MEAN SUNSHINE.

September	52	71	62	57	60	62	50	62	80	70	73	70	59
October	42	58	60	66	68	54	63	39	55	56	72	57	55
November	65	52	48	49	53	54	57	49	57	52	63	68	53

MONTHLY MEAN WIND VELOCITY.

September	5.5	6.3	7.3	8.9	7.6	8.9	7.5	8.0	8.1	8.4	9.1	7.8	8.7
October	6.8	8.7	8.7	8.6	9.8	9.0	8.1	8.8	7.9	8.8	9.5	10.4	8.2
November	7.2	9.7	8.8	10.5	9.9	10.0	9.7	8.8	10.5	9.6	8.8	9.3	8.9

MONTHLY MEAN PREVAILING WIND DIRECTION.

September	nw.	sw.	n.	n.	n	n.	n.	n.	n.	nw.	s.	n.	n.
October	ne.	n.	n.	w.	nw.	n.	n.	n.	s.	s.	n.	n.	s.
November	nw.	n.	n.	w.	nw.	w.	sw.	n.	n.	sw.	sw.	nw.	ne.

MONTHLY MEAN CLOUDINESS.

September	4.8	2.9	4.0	4.9	4.7	4.6	6.0	5.3	3.3	4.2	3.7	4.7	5.1
October	5.8	4.2	4.3	4.0	4.1	5.3	4.7	6.7	5.2	5.1	3.8	5.2	5.1
November	3.5	4.8	5.3	5.7	5.4	5.4	5.2	5.8	4.8	5.2	4.3	3.8	5.1

MONTHLY MEAN HUMIDITY.

September	85.3	81.6	73.0	76.8	77.2	74.8	77.6	76.0	65.8	77.6	73.4	70.0	75.6
October	80.4	77.7	73.0	76.8	68.2	75.0	71.4	77.8	72.0	83.4	75.4	74.4	76.6
November	76.0	74.0	71.8	68.3	71.0	67.8	68.4	68.3	65.0	68.1	76.4	61.0	70.2

To get an idea of what happened during the nine weeks' period from September 2 to November 9, in a meteorological study we have made a chart (omitted) of the mean daily temperature for September, October, and November, 1918, and also for these months for the last 10 years, and have compared them with the same months for the years 1890–91. We also have made a daily chart covering the same period for precipitation, humidity, sunshine, cloudiness, wind velocity, and wind direction. As a rule the epidemic began and reached its height in the eastern portion of the country in the same manner as it did in 1890.

A New England weather station was taken for observations because, like the epidemic in 1890, it commenced in New England and spread westward in a fan-shaped manner. As will be noted by the chart, the precipitation for the first 18 days of September was nearly 5 inches. This is a very unusual rainfall. In September of 1890 it is noted that the precipitation was also over 5 inches. The only bearing it has on acute respiratory conditions is the tendency to drive people inside and to cause crowding. So far as the other meteorologic observations are concerned, there is nothing unusual as in comparison with the period of the last 10 years.

The time it took to exhaust the susceptible material was not more than eight weeks in any one place. The death rate was highest in manufacturing and lowest in strictly rural communities. All towns untouched by railroads showed a very low death rate. Conditions of housing and crowding which increased indoor contact, no matter where found, increased the death rate. The comparison of these rates with the proportion of foreign and native born shows that in the communities having the highest and lowest percentage of native born the death rate rises or falls accordingly, as a high percentage of American born means less crowding and better sanitary conditions generally.

The study of the Student Army Training Corps and students wherever located shows that as living conditions approach those in the Army so does the death rate approach that of the Army, i. e., when a large number of persons live, sleep, and eat together in a large barrack room the death rate is almost invariably higher. This is true no matter where people are housed in this manner, whether in Army camps, miners in South Africa, or the congested sections of our cities with their apartments, flats, and tenements. It is noteworthy that in many of our large western and southern cantonments the morbidity and mortality was as high or higher than in many of our eastern camps, so that climatic influence does not explain the difference nor does it explain the difference in morbidity of influenza in cantonments of 15.9 per cent being complicated with pneumonia in barrack camps against 9 per cent in tent camps where the men were quartered in small groups of five or six men to a tent against 50 to 150 in a barracks building.

This has also proven quite true of institutions and industrial plants where the same sort of housing has occurred. Already we have been impressed with the heavy sacrifice in human lives demanded for the privilege and necessity of assembling large numbers of men in barracks for military, industrial, and educational purposes.

What relation was there between bronchitis and climate? The weather may have encouraged it, but while there was a good deal of cloudiness and perhaps unusually cold weather in the fall and winter of 1917, yet there was no unusual humidity or precipitation—only the snowfall was greater.

I think we must admit, however, that climate, so far as seasons go, does play a great part in the incidence of acute respiratory diseases, especially pneumonia. We must look further than climate, however, for the explanation of these diseases during the winter of 1917. I have always believed that no climate can rise above the conditions of housing. The quartering of troops in unaccustomed climates will not explain it, but the housing of a large number of men together in one room with the change from overheated homes to the more or less cold barracks system of many of our camps, will account for much of it, but this condition was not confined to our Army camps. Acute respiratory conditions were on the rampage during the winter of 1917 among the civilian population, and I believe the foundation for the pandemic of the autumn of 1918 was then laid.

The following statement may surprise you all, but I believe that the fuel administration had the most to do with the causes which led up to the titanic struggle between bacterial and human life. Not that they were to blame. It was a military necessity. And, my friends, it is impossible for us to play at this war game without paying for it in both the front line and the extreme rear line or the homes that were necessarily mobilized for war purposes.

During the winter of 1917, on account of fuel shortage many people were obliged to close a large part of their houses and to live in a few rooms. This was especially true of the poor. Apartment houses were crowded and poorly heated. The people who could afford it flocked to hotels, many of which were under heated and overcrowded. People crowded together as never before witnessed in the civil population of all countries. Windows and doors had to be kept closed to keep the cold out, which resulted in a concentration of bacteria laden, indoor air, due to coughing and sneezing. The acute respiratory conditions in 1917, I feel, had some very definite relation to those in 1918. As the warm weather approached in the summer of 1918, these conditions subsided because windows were opened and people had reopened their closed rooms; the concentration of germ laden air had become diluted and it almost appears that a certain concentration is necessary for the spread of some of these diseases.

I have failed thus far to show any meteorological factor that influenced the pandemic with the exception of change in seasons. Does climate have any effect on the bacterial flora in any sense as it does on our terrestrial flora? This is a question that will bear some investigation.

* * * I feel that climate will have little to do with the next outbreak but it will come, perhaps not in my time and perhaps not for a longer period of time, but you climatologists who are present when a new susceptible population is established need not study meteorological influences or protections against it except so far as it concerns seasons. I do earnestly urge you to study housing, ventilation and sanitation and to be ever on the watch for business depressions, social problems such as widespread strikes, and new wars, which for economic reasons will cause people to live under restricted and crowded conditions.

THE CONTROL OF PNEUMONIA AND INFLUENZA BY THE WEATHER.

By ELLSWORTH HUNTINGTON, Research Associate in Geography, Yale University.

[Review and discussion by J. B. Kincer, Meteorologist, U. S. Weather Bureau.]

In the January, 1920, issue of *Ecology*, the official publication of the Ecological Society of America, Prof. Ellsworth Huntington gives in considerable detail the results of an investigation made by him as to the relation of temperature and relative humidity to the number of deaths from pneumonia in New York City for the period from April, 1917 to March, 1918.

He points out that in former investigations of this character the monthly figures of deaths have been compared with the weather conditions of the particular month, and these have indicated that deaths from pneumonia have a direct relation to outside temperature and decrease systematically as the temperature rises.

In order to test the matter in another way, Prof. Huntington has taken the day instead of the month as a unit and has tabulated the deaths from lobar and broncho-pneumonia in conjunction with the outside temperature for the particular day on which death occurred. For this purpose he has made 8 divisions of temperature for the period, namely, 20° or less, 21°–32°, 33°–45°, 46°–55°, 56°–65°, 66°–70°, 71°–75°, and over 75° F.

TABLE 1.—*Average daily deaths from pneumonia at various mean temperatures in New York City, from April, 1917, to March, 1918.*

Mean temperature, °F.	20° or less.	21°–32°	33°–45°	46°–55°	56°–65°	66°–70°	71°–75°	Over 75°.
Lobar-pneumonia...	26.5	26.4	27.8	20.6	17.4	9.4	6.3	6.7
Broncho-pneumonia.	8.3	9.6	8.2	6.2	5.4	3.9	2.5	3.3
Number of days.....	30	47	72	70	51	31	38	26

Table 1 shows the number of deaths reported under each of these groups of temperature. This table indicates a decline in the death rate with rising temperature. His comment on the table is as follows: "At the lowest temperatures there is a little irregularity, due to the fact that a mild epidemic doubled the death rate for a couple of weeks at the end of March. In view of the lateness of the season at which this occurred, it is surprising that the death rate at temperatures of 33° to 45° has not been raised much higher. In ordinary years the relation between low temperature and the death rate would be even stronger than appears in Table 1. At the right-hand end of the table a slight increase in deaths is apparent at high temperatures, above 75°. Judging by more abundant statistics for other diseases, this is a constant characteristic, and means that high temperatures as well as low are bad for pneumonia."

As a test of Shaw's [1] conclusion that influenza as well as pneumonia varies inversely with the temperature, Prof. Huntington has used the weekly figures for deaths from influenza in New York City during the 30 years from 1889 to 1918 and presents these data by means of a graph. He points out that deaths begin toward the end of September or at about the time when the nights first become frosty; the death rate suddenly increases about the middle of December, at approximately the time when the mean temperature falls below freezing, and reaches a maximum a little after the middle of January, or the time of minimum temperature.

[1] Napier Shaw, *Quar. Jour. Roy. Met. Soc.*, Vol. XLV, July, 1919.